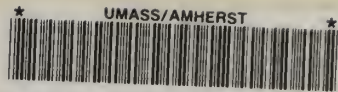


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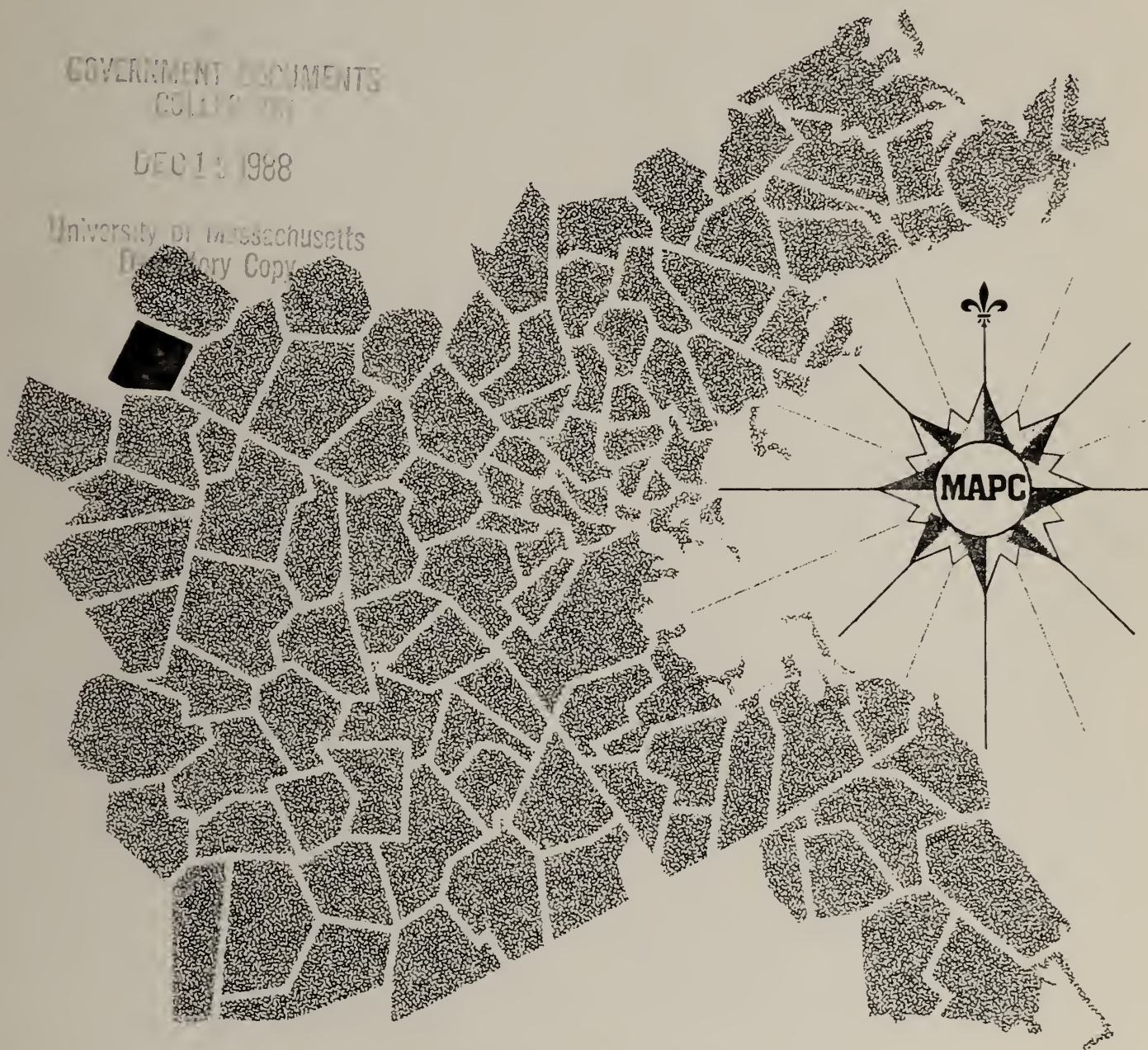
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ACCESS STUDY: Zoning District 8, Boxborough

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Zoning District 8, Boxborough

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TABLE OF CONTENTS

	Page
Background	1
Problem Statement	3
Development Potential	4
Access Issues	6
Physical Constraints	6
Legal Constraints	6
Extension of Whitcomb and/or Leonard Roads	9
Methods	9
Consequences	10
Traffic Management at Hill and Whitcomb	12
Policy Options	14
Zoning Changes	14
Public Road through District 8	15
Conclusion	16

Background

Boxborough lies in the region northwest of Boston often referred to as the Minuteman area because of the association of the towns around nearby Concord with revolutionary events. Until recently, Boxborough was a quiet farming community. In 1955 its population was 500. With the construction of Interstate 495, however, Boxborough has been transformed by an influx of single- and multi-family housing and high-tech corporate headquarters and plants; at present its population is over 3,000.

I-495 runs through the western part of the town, angling slightly away from the Harvard line as it goes from south to north. This major highway was conceived as an "outer beltway" around the Boston metropolitan area and has to some extent begun to repeat Route 128's pattern of attracting major employers to sites readily accessible to it. I-495 has created the conditions for rapid economic development in west Boxborough, particularly near the Route 111 interchange. In the immediate area, new corporate development is proposed or has already been done by Sheraton, NEC, Mann/Hines, GenRad, PTS and Winstanley.

These developments and others are made possible by the existence of zoning along both sides of I-495 which permits industrial and commercial uses. This zoning envelope allows the town to take advantage of the growth which I-495 makes possible while still containing that growth within the highway's immediate vicinity (there are also industrial-commercial zones at the other, eastern end of Route 111 and in the northeastern corner of town).

I-495 makes the industrial-commercial zones that abut it accessible in the sense of making travel to west Boxborough relatively easy from Route 128, the Massachusetts Turnpike, and via them from almost anywhere in eastern Massachusetts. I-495 is a limited access highway, however, and so it cannot provide access to individual sites alongside it. The only way to get from the highway to the land next to it is to exit at Route 111 and use a local road.

Of the four industrial-commercial districts demarcated by I-495 and Route 111, three are served directly by local roads: Harvard, Codman Hill and Swanson Roads either penetrate or border the districts at the southeast, southwest and northwest corners of the interchange, respectively. The zone at the northeast corner, however, is different from the others in that it is almost entirely removed from public rights-of-way. This zone, designated in the Boxborough zoning bylaw as District 8, is composed primarily of a narrow strip running the length of I-495 from Route 111 to the Littleton town line, and 750 feet in width from the line of the I-495 taking (see Figure I). Of the four zones, District 8 is unique in being delineated by neither topographic features, local roads nor town boundaries, but in terms of an arbitrarily selected distance from I-495.

Due to this method of delineation, the borders of the district do not correspond to property lines; many lots are split between industrial-commercial and agricultural-residential zoning. A number of the lots do front on Hill Road, a local road running very roughly parallel to I-495, but the frontage is all within the basic residential-agricultural zone. It will be discussed in detail below why lots which abut Hill Road still may not have drives or roads built on them which provide access to their industrial-commercial zoned portions.

Although District 8 has been in existence since I-495 opened, it appears that except for the GenRad site, none of the land within it has been recently purchased by developers, speculators or others with the idea of constructing office, industrial or commercial space. The possible exception is lot 222, which was purchased in 1982; besides that all the other lots last changed hands before 1975, most long before.

The GenRad site is planned as a corporate headquarters for the high-tech firm. Negotiations with the town have taken place regarding access to lot 105 via a short road through lots 103 and 104 crossing (and perhaps replacing) Cunningham Road. The approved site plan for the development does not include provisions for any public road across lot 105 which would make it possible to get to the adjacent lot within District 8 (#109).

At present, then, only two public ways let directly into District 8. One is Whitcomb Road, a former thru street which was severed by I-495 and is now a dead end. It runs between lots 109 and 158, which both are owned by the same trust. The other is Leonard Road, a short cul-de-sac which enters Boxborough from Littleton on the northern end of District 8 and serves lots 173-178.

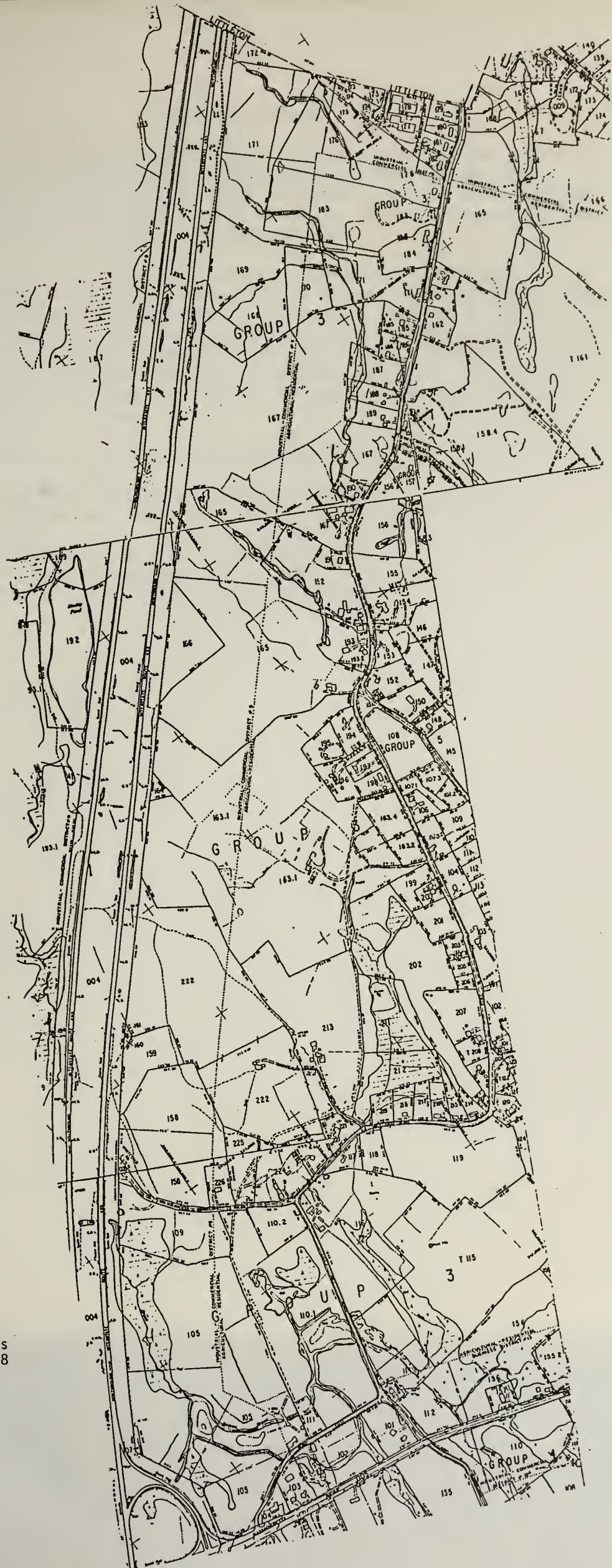


Figure II
Study Site,
showing numbered lots
and Zoning District 8

Problem Statement

Members of the Boxborough Planning Board are concerned with the problem of access to the lots on the interior of District 8. This concern is twofold: first, how much traffic might ultimately be associated with the industrial-commercial tract if it were developed to its full capacity, and second, how could that traffic be accommodated?

An estimate in answer to the first question can be derived from the available acreage and standard factors for trip generation provided by the Institute of Transportation Engineers. The second question is more complicated, involving legal, zoning policy, and engineering issues. This report will provide rough estimates of potential traffic generation, and a discussion of the issues surrounding the access question. No recommendations will be made, but rather various options presented and their implications discussed.

The Town's action in this regard should be based on:

- o its long-range planning and fiscal goals;
- o the concerns and preferences of residents along and near Hill Road;
- o the ultimate disposition of the GenRad site;
- o the availability of funds for roadway improvements;
- o the resolution of certain legal and zoning issues.

Development Potential

In estimating the amount of traffic which might be generated by developments within District 8 if it were developed to its fullest capacity, the first step is to determine how much industrial or commercial space could be built there under current zoning regulations. Usually the calculation is based on measurements of lot size, the zoning code's height restrictions and its stipulation of the maximum proportion of a lot which a building or buildings may cover. This case, however, is complicated by the Boxborough zoning code's lack of a maximum-lot-coverage regulation. Instead, the code relies on building set-back requirements, which cannot be used as a measure of how large a building's footprint may be because they do not account for parking space. Rather than undertake the arduous and imprecise measurement of maximum building size by subtracting required parking space from lot size (a process which would necessitate the solution of simultaneous equations), MAPC decided to base its calculations on a reasonable standard of maximum lot coverage. As it turns out, the Town of Acton has, under Standard Dimensional Regulations in its Zoning Bylaw, a regulation for industrial uses which stipulates a "Maximum Building Coverage" of 35 percent of a given lot. In light of Acton's and Boxborough's proximity and similarity, it seems appropriate to assume that the density of development within the entirety of district 8 would not exceed the maximum allowed by the Acton zoning code.

Other assumptions went into the calculations of potential trip generation of district 8 at maximum build-out. It was assumed that all the lots would be developed in their current form, that is, that they would be neither consolidated nor subdivided. No allowance was made for the very real possibility that some land may need to be taken for roadways to serve the interior lots. The line between the industrial-commercial and agricultural-residential zones was treated like a property line: the agricultural-residential portion of a lot is not counted in making the calculation of maximum percent lot coverage.

Table I shows, for each lot within District 8, the approximate acreage; the potential maximum square footage of a building on that lot, given a 35 percent lot coverage and a three-story height limit; and the potential weekday trip ends (vehicles coming or going), depending on whether the lot is in industrial, industrial park or office use.

The trip generation calculations use the Trip Generation manual of the Institute of Transportation Engineers (ITE), which gives estimates in terms both of trips per acre and trips per square foot of gross building floor area. Estimated potential trip ends were given on the basis of both factors, to give a sense of the range of possible outcomes. The discrepancy between the methods -- the per-square-foot method yields estimates mostly about four times those from the per-acre -- points up the difficulty of predicting the traffic impacts of vaguely imagined real estate development. Since the higher figures based on potential square

Table I - Boxborough - Lots in I-495 Corridor, East of Highway, North of Route 111

LOT #	Acres Zoned Industrial-Commercial	Acres Zoned Agricultural-Residential	Potential (3 stories 35% lot coverage)	Potential Weekday Trip Ends				
				General Light Industrial (ITE 110)	Warehouse (ITE 150)	General Office Bldg. (ITE 710)		
				/sq. ft. * -----	/acre ** /sq. ft. * -----	/sq. ft. * -----	/acre ** -----	
105	38.0	10.0	1,740,000	12,100	2,900	8,500	25,800	11,300
109	7.0	<1.0	320,000	2,200	500	1,600	4,700	2,100
158	13.0	<1.0	595,000	4,200	1,000	2,900	8,800	3,900
159	4.0		183,000	1,300	300	900	2,700	1,200
160	<1							
161	<1							
222	18.0	1.5	823,000	5,700	1,400	4,000	12,200	5,400
163.1	24.0	35.0	1,100,000	7,700	1,800	5,400	16,300	7,200
164	<.5							
165	30.0	11.0	1,370,000	9,600	2,300	6,700	20,300	9,000
166	5.0		229,000	1,600	400	1,100	3,400	1,500
167	21.0	21.0	960,000	6,700	1,600	4,700	14,200	6,300
168	6.0		274,000	1,900	500	1,300	4,100	1,800
169	6.0		274,000	1,900	500	1,300	4,100	1,800
170	1.5	2.0	69,000	500	100	300	1,000	400
171	15.0	7.0	686,000	4,800	1,100	3,300	10,200	4,500
172	1.0		46,000	300	100	200	700	300
173	<1.0							
174	<1.0							
175	1.0		46,000	300	100	200	700	300
176	8.0	5.0	366,000	2,600	600	1,800	5,400	2,400
177-182	<1.0							
200 (approx.)				63,400	15,200	44,200	134,600	59,400
				9,081,000				

* Calculated on the basis of trips/sq. ft. of building floor space
** Calculated on the basis of trips/acre of land.

footage assume that every lot is developed to its very limit, it would be wise to consider them to represent an extreme unlikely ever to happen, even if Boxborough decided to pursue complete industrialization of its I-495 corridor: a worst-case scenario in terms of traffic. The trips-per-day-per-acre calculations are probably closer to what might be seen if the whole of district 8 were developed at the same level of intensity as is proposed, say, for the GenRad site: that is, somewhat less densely than the zoning code would permit.

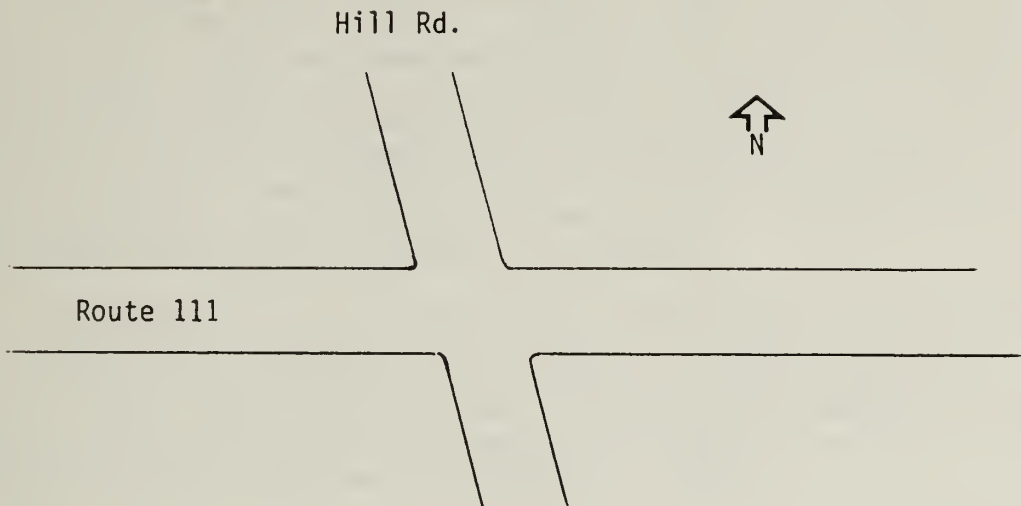
Table II shows 1982 volumes along Route III, as well as volumes projected for 1988 and 1991, showing the influence of already planned new development along Route 111. As is clear from a comparison of Tables I and II, the development of District 8 has the potential to bring about a major increase in the amount of traffic in the area. Without prejudging the question of how all these vehicles would gain access to the industrial-commercial zone, it can be said that if half of them came and went via Route 111, the result would be a five-to-tenfold increase in peak hour volumes along Route 111 over what is projected for 1991 with none of district 8 except the GenRad site developed. If the other half used other roads (Hill Road or Leonard Road north to Liberty Square Road and thence to Route 2 or I-495), the impact on those smaller roads as well, undoubtedly, as on Liberty Square Road would be tremendous.

As the above indicates, if the whole of District 8 were to be developed to its full potential under current zoning, the area would be transformed from its current, quiet condition into one more closely resembling the busiest section of I-495 in Southborough and Marlborough. As is true for all communities lying astride I-495, the example of Route 128's effect on the inner suburban communities stands as a concrete "worst case" in terms of traffic.

This is not to say, of course, that even under conditions of the most intense growth, the I-495 corridor would ever closely resemble the Route 128 corridor. Route 128's traffic and the shape of its abutting land use are a function of its proximity to Boston and the independent size of the communities it runs through (Waltham, Woburn, Dedham, et. al.). If the I-495 corridor becomes "fully developed", its development will probably be less oriented toward town centers than is Route 128's, and based more on long-distance commuter travel. It is highly unlikely that demand for exurban office space will ever reach such a level as to bring every acre permitted by zoning under development. The figures in Table I should be seen, not as a prediction of future conditions, but as a measure of the capacity of a particular piece of land to support industrial and commercial use simply in terms of area and the restrictions imposed by the zoning code. For certain types of land use, such as general business and industrial-commercial, town zoning bylaws generally allocate more land area to that type than the bylaw's framers intended should ever actually be developed for that purpose. The reason is that zoning bylaws are often designed to designate certain places as appropriate for certain types of development, rather than to allocate the amounts of different types that are expected or desired within the town. It is only under conditions of rapid growth, particularly growth of types of land use which are new to the town, that the question arises of how much of it the town can hold, both practically and under the terms of the zoning code.

Table II

Projected Traffic, Route 111a Hill Road



1988

Approach	111 EB			111 WB			Hill NB			Hill SB		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume	3	506	30	12	468	5	76	1	28	3	2	13

1991

Approach	111 EB			111 WB			Hill NB			Hill SB		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Volume	9	718	30	13	526	6	76	1	28	3	2	13

Source: Boxborough Industrial Corridor Study, On-site Insight, February 1985

Access Issues

Physical Constraints

Although the land adjacent to I-495 is zoned for industrial-commercial use, most of the rest of Boxborough is relatively undeveloped. Originally a farming village, Boxborough has a land use pattern which reflects the gradual development of farmland for residential use. Hill Road is typical: the houses which line it occupy lots, many of which were sold off from larger agricultural parcels. The result is a semi-rural geography, in the sense that even though active farms do not predominate in the landscape as they did a generation ago, the agricultural lifestyle is a model for current landscape and domestic architectural practices. Two- and three-acre lots are common even for residential properties having no farming function. The pattern is one which, if current trends continue, could become what is often called "exurban." Present conditions in Acton suggest what may lie ahead for Boxborough.

In this context, the prospect of industrial development along the east side of I-495 north of Route 111 is problematic. Boxborough's pastoral air is something its residents wish to preserve, and Hill Road is as pleasant a country lane as any in town. The industrial-commercial zoning of the land a short distance to the west of Hill Road represents a threat to the stability of conditions on and along Hill Road.

The zoning of land on either side of I-495 for industrial-commercial use dates from the construction of the highway itself. When districts 8,9,10 and 11 were established, the expectation was that district 8 would be made accessible by means of a public road extending from Route 111 to either Hill Road's northern end or to Liberty Square Road (traversing a small area in of south Littleton). The result might have been a frontage road, running directly alongside I-495, or a more winding road through the interior of District 8. In any case this option was foreclosed by the Town's acceptance of the site plan for the GenRad development. That plan, for the corporation's headquarters, was designed to create a private setting and so included no provision for a road permitting thru traffic. As currently envisioned, development of the GenRad site (lot 105) would seal off District 8 from direct access to Route 111.

Legal Constraints

It thus appears that, unless plans for the GenRad site are changed so as to include a thru drive linking Route 111 to lot 109, or unless a similar drive is built as an extension of existing public roads, access to District 8 will only be possible by public roadway. At present the only public roads which enter the interior of district 8 are Whitcomb Road and Leonard Road. The former is a road which was severed by I-495 and which now dead-ends at the edge of the I-495 taking. It is abutted only by one structure along its length from Hill Road to I-495, a single-family house situated just outside the industrial-commercial zone. Leonard Road is a short cul-de-sac which crosses over the Littleton border from the north. It serves a cluster of small lots containing residential condominiums.

In addressing issues of how, and with what consequences, the town could provide public access to District 8, it is first instructive to discover the implications of its not doing so. This involves examining the Boxborough zoning bylaw to see how the land in district 8 could be used if the only access to it were by private roads or drives originating at Hill Road.

A number of the lots lying partially within District 8 also extend, through land zoned for agricultural-residential use, to Hill Road. (These are lots 163.1, 165, 167, 171 and 176.) Some of these have been subdivided in such a way as to retain a finger of land extending from the large tract within the industrial-commercial zone to Hill Road, apparently in the belief that this leaves the option to build a private drive. However, such an option does not exist, because an access road is an "accessory use" which is, by zoning law, considered to have the same zoning classification as the use to which it is accessory. That is, a drive constructed as an accessory to an industrial or commercial use constitutes an industrial or commercial use itself. Such a drive would not be permitted across agricultural-residential-zoned land. Nor could a variance be granted, for Boxborough's zoning bylaw does not provide for use variances. In order for a drive connecting Hill Road with District 8 across agricultural-residential-zoned land to be permitted, a rezoning of the land it covered would be necessary. Such a rezoning, however, might be challenged (by abutters, for instance) as illegal "spot zoning," zoning a specific parcel of land for the benefit (or disadvantage) of a specific owner rather than the public good.

Access cannot be provided to District 8 across land zoned for agriculture or residence unless the use for which the access is provided is itself agricultural or residential. In most zoning codes, agriculture and homes would be permitted in a district zoned for more intense use. Were that the case in Boxborough's zoning bylaw, those parts of District 8 which were not accessible by public road, and so were not permitted to have industrial-commercial use, would still be eligible for residential construction. However, in Boxborough's zoning bylaw there is no provision that less intense uses are permitted on land zoned for more intensity.

It would therefore appear that for those lots which are not served by a public road (all but #105, 109, 158 and 173-8), there is no use to which those portions of them lying within district 8 can legally be put. Access for industrial-commercial use is not allowed by private drive, and no other use is permitted by the zoning bylaw. When, through the zoning code and/or other laws or regulations, private property is rendered useless (and therefore worthless), the result is known as a constructive taking, and the government responsible may be required to compensate the owner of that property in the amount the land would otherwise have been worth. The situation as it currently stands seems to amount to a constructive taking of part or all of lots 159, 160, 161, 222, 163.1, 164, 165, 166, 167, 168, 169, 170, 171 and 172.

As of yet, no landowner has chosen to challenge the Boxborough zoning bylaw over its regulation of land use in District 8. As mentioned above, some may be under the impression that a private road across their own agricultural-residential land to serve industrial or commercial use in District 8 is permitted by right. As soon as the owners of one of the affected lots wishes to develop it, the problem will become apparent; in the meantime, it adds urgency to the need to deal with the question of access to District 8.

Extension of Whitcomb and/or Leonard Roads

Methods

Under current conditions, besides the GenRad property only the lots abutting Whitcomb Road and Leonard Road are accessible. If lot 158 or 176 were to be developed, there would be an opportunity to secure access to the interior of district 8 by extending the existing roads across the properties, ending them with a cul-de-sac or "stub" at the property line. When the adjacent lot is developed, the road could be continued in the same fashion, and so on until, in a piecemeal fashion, each of the lots in District 8 is reached by a road. Supposedly, if this process occurred at both the north and south ends, eventually the two roads could meet in the middle, providing thru service from Whitcomb Road to Leonard Road. If a developer would build the road as part of the development's design, the result would be attractive and the town would have a road at no cost.

This scenario is attractive, but problems appear as soon as the details are addressed. In the first place, there is no reason to think that the owners in District 8 will want to develop their properties in convenient order. For example, the Whitcomb family estate's lands on either side of Whitcomb Road currently have a Chapter 61 Forest Land Certificate, whereby they are assessed at a below-market value in exchange for a guarantee that they not be developed for a specified period of time. If lot 158 is not developed, there is no way that Whitcomb Road can be extended northward. By the same token, if the owner of an interior lot, say lot 222 (which was purchased in 1982), wished to develop the property before its neighbor was developed, there would be no means of access.

Assuming that the lots in District 8 were developed in neat order from the ends inward, the question would remain of what power the Town has to see that the roadway is extended all the way across each lot so as to make the next one accessible. Some development schemes may require precisely that there not be thru traffic across the lot. The GenRad development is a good example of a site plan which relies on a cul-de-sac to ensure the privacy of the corporation's headquarters.

Thus the question arises of what sort of influence the Town can exert on developers to guarantee that the access road is extended to each lot. In terms of law and regulation, the Town's powers are limited. It cannot require that an owner do any particular thing with any part of his or her property. It cannot, for example, require that a property-owner who plans to develop a lot extend a private drive to the border of an adjoining lot. Even in the case of subdivision, which is governed by the Town's Subdivision Regulations, the owner cannot be compelled to follow a specified street layout. As stated in Chapter 41, section 81Q of the Massachusetts General Laws, "No rule or regulation shall require, and no planning board shall impose, as a condition for the approval of a plan of a subdivision, that any of the land within said subdivision be dedicated to the public use, or conveyed or released to the commonwealth or to the

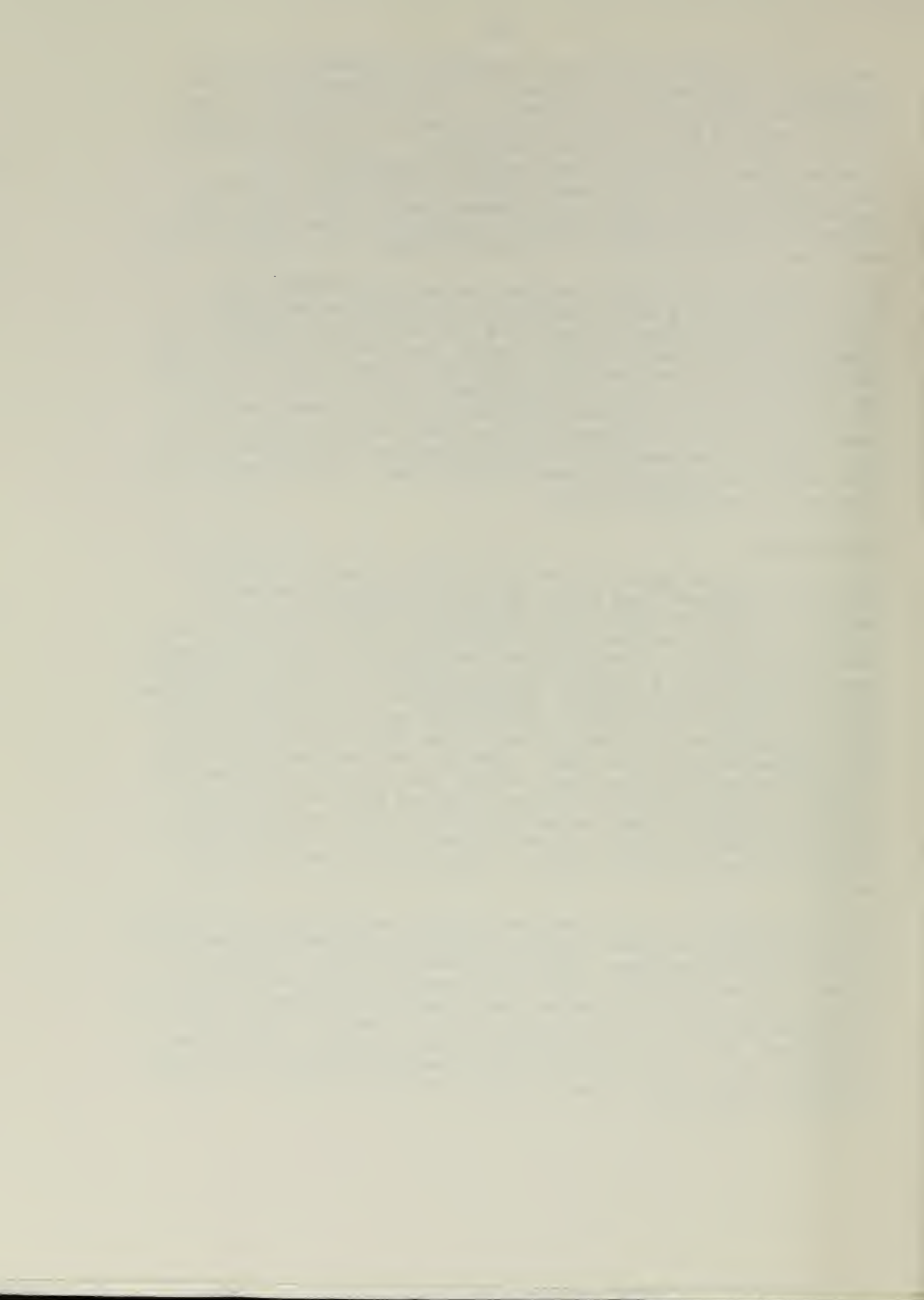
county, city or town in which the subdivision is located for use as a public way, public park or playground, or for any other public purpose, without just compensation to the owner," which is what requiring that a public roadway be put in a specified place amounts to (emphasis added). This law leaves the town with only two options: to acquire right-of-way by eminent domain or, by working closely and negotiating with owner-developers, to secure construction of a road through voluntary cooperative agreement. The latter approach could involve either the dedication of public right-of-way or a private drive controlled and maintained by an association of the property-owners whose land it crossed.

While the details of negotiations for a voluntary commitment from developers to build a road through District 8 cannot be determined in advance, there are steps the Town could take to set their context. For example by drafting and adopting a "Master Plan" for the District and its immediate environs, the Town could establish the goal of building a road and the desirability of obtaining developers' contributions. A standard could be set for the assumption of responsibility for improvements, proportional either to the amount of land owned within District 8 or to some measure of the benefits derived from the road. The existence of a plan would enable the Town to deal with developers equitably and from the standpoint of established policy.

Consequences

There are, as shown above, currently two points of public access to District 8: Whitcomb Road at the south end and Leonard Road at the north. If GenRad goes ahead with its plans to build its corporate headquarters at the southern end of District 8, direct access from the rest of the district to Route 111 will be impossible. Without an eminent domain taking and/or a rezoning, the only access to District 8 from the south will be by Whitcomb Road. As undesirable as is the use of Whitcomb Road by industrial and commercial traffic, it may be unavoidable. The following estimates will give an idea of the impacts of such traffic on both Whitcomb Road and Hill Road. There are four permutations of road design using one or both entries: a thru road connecting Whitcomb with Leonard; a long cul-de-sac extension of Leonard Road providing access to all lots in District 8 not served by Whitcomb Road; contrariwise, an extension of Whitcomb Road; and two cul-de-sacs which together serve all lots but do not allow thru traffic. Figures III-VI show the design options.

Table III shows, for each of the four possible basic designs, the amount and percentage of peak-hour traffic which could be expected to be put onto Leonard and Whitcomb Roads. The trip generation factors used were those given by ITE on a per-acre rather than a per-square-foot-of-building basis, in the belief that the per-square-foot basis represents an outside limit when applied to a 160 acre area which at present is completely undeveloped, and in an effort not to be unduly alarmist. The figures in Table III, then, should be seen as fairly modest estimates of the amount of traffic which might be seen if each of the lots in District 8 were ultimately developed.



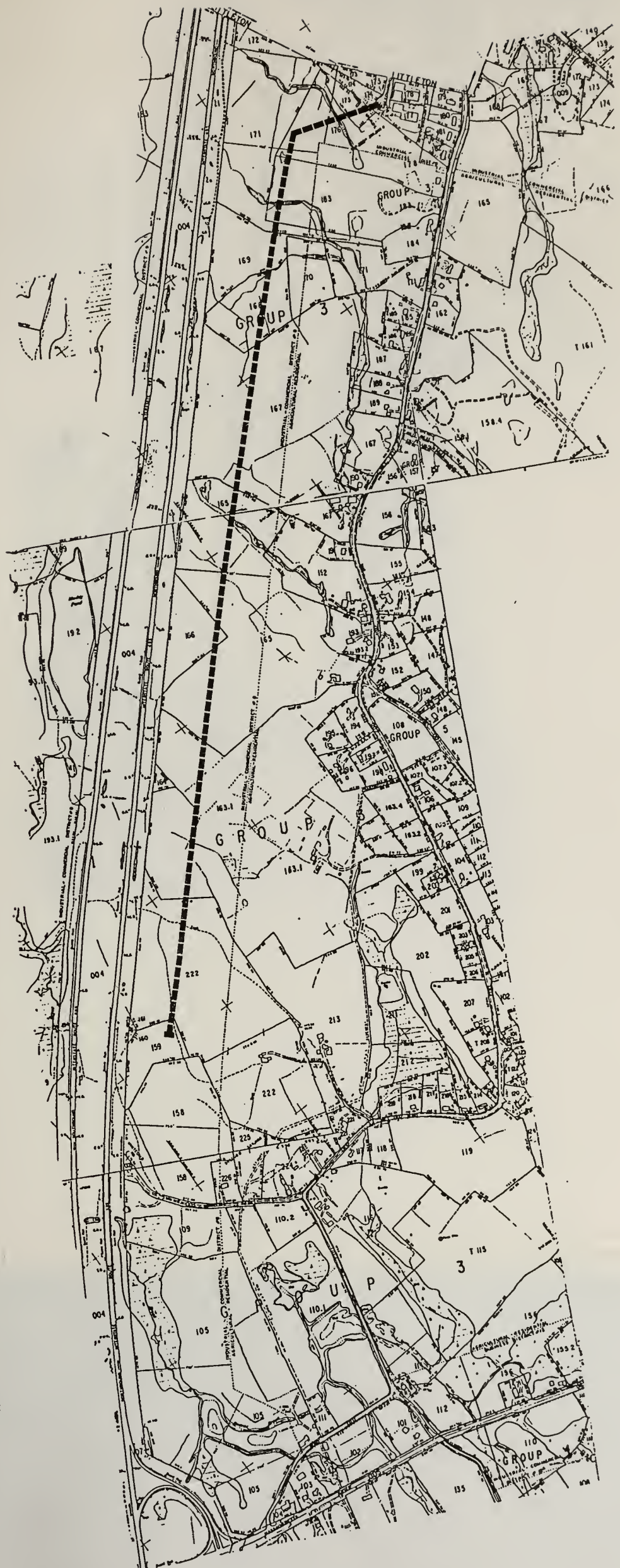


Figure III
Design Option 1:
Leonard Rd. Cul-De-Sac

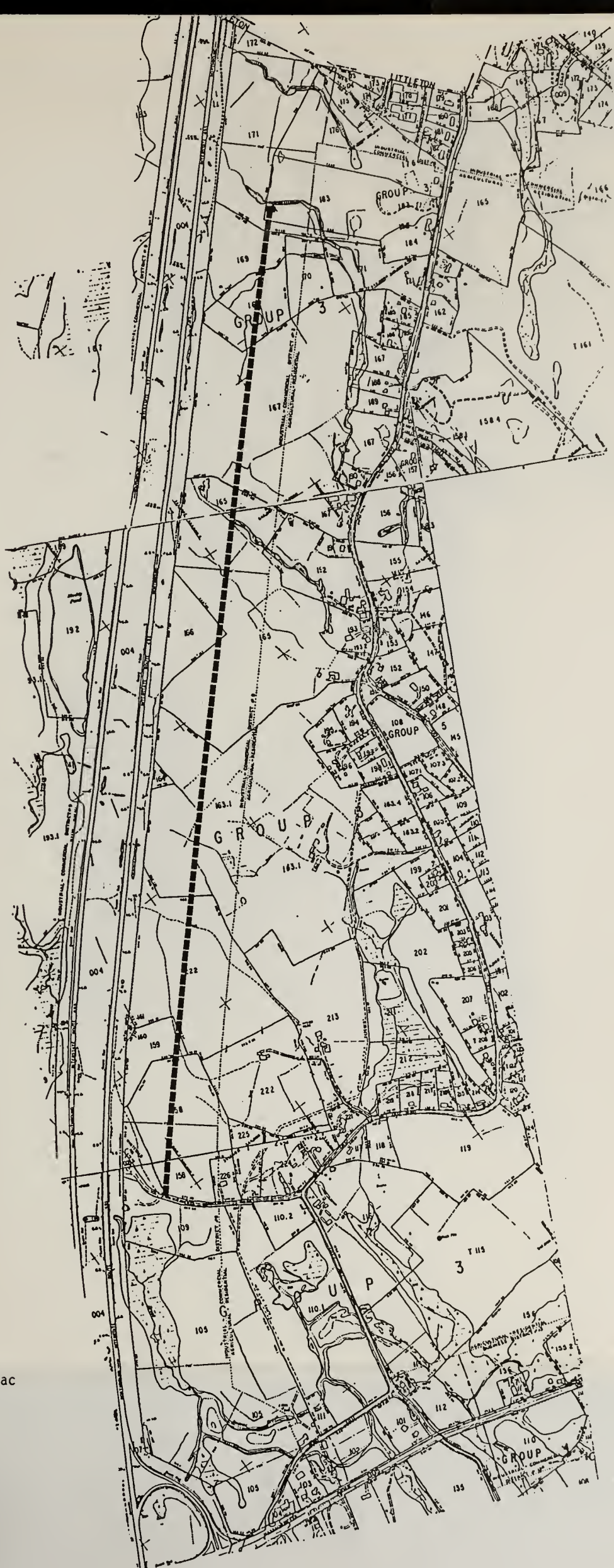


Figure IV
Design Option 2:
Whitcomb Rd. Cul-De-Sac

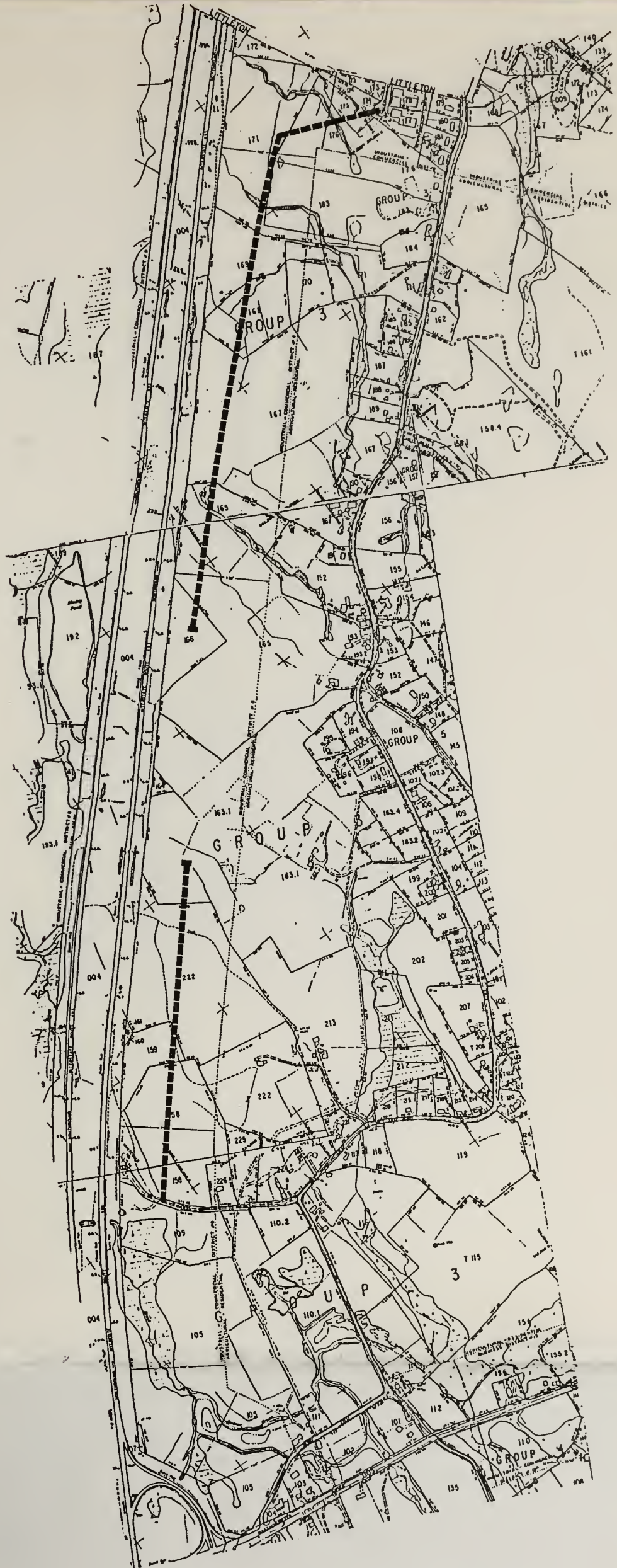


Figure V
Design Option 3:
2 Cul-De-Sacs



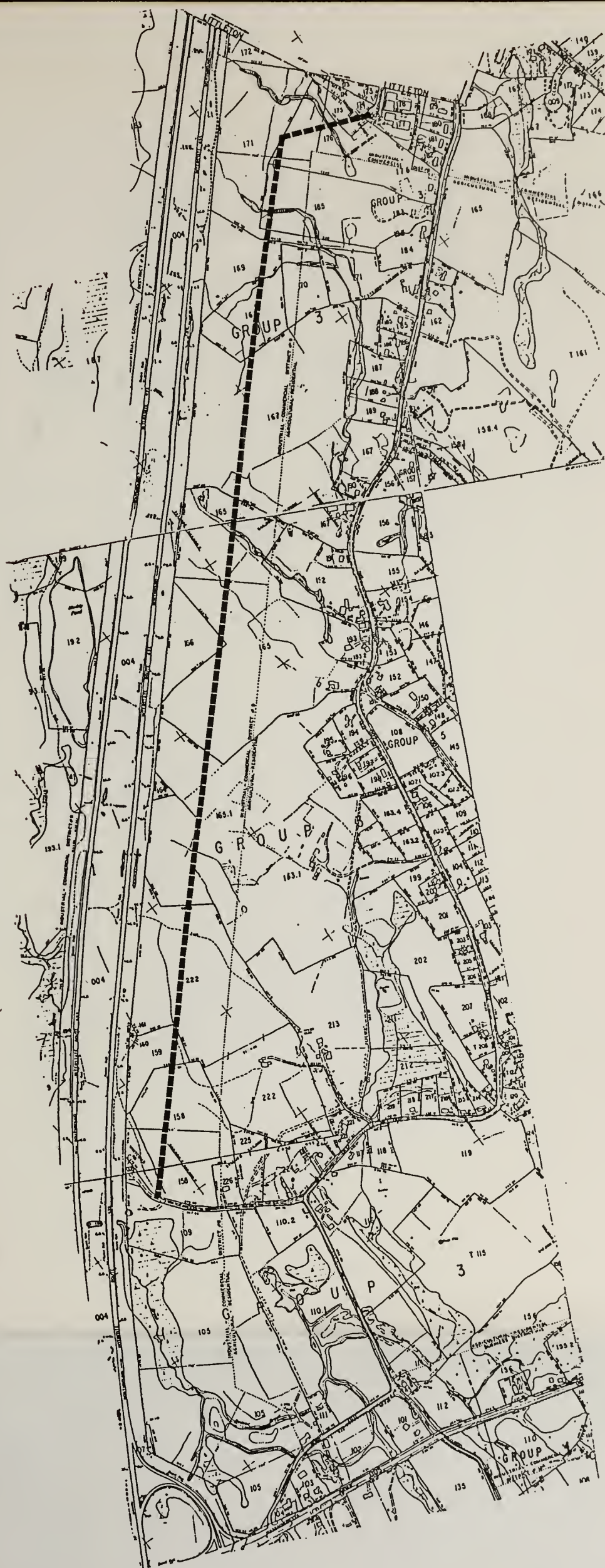


Figure VI
Design Option 4:
Leonard-Whitcomb
Connector

TABLE III Distribution of District 8 Traffic, by Access Road Design

Design Options		Intensity Options					
		A Industrial Use (ITE 110)			B Office Use (ITE 710)		
		Leonard Rd. A.M.	Leonard Rd. P.M.	Whitcomb Rd. A.M	Whitcomb Rd. P.M.	Leonard Rd. A.M.	Whitcomb Rd. A.M. P.M.
1	Leonard Rd. cul-de-sac	1,418	1,267	0	0	4,208	4,122 0 0
2	Whitcomb Rd. cul-de-sac	0	0	1,418	1,267	0	0 4,208 4,122
3	2 cul-de-sacs: Whitcomb - lot 163.1; Leonard - lot 166 (41% via Whitcomb, 59% via Leonard	837	748	585	523	2,472	2,421 1,736 1,700
4	Leonard-Whitcomb	709	634	709	634	2,104	2,061 2,104 2,061

Given these figures, it is possible to make some rough assessments of what traffic conditions along Hill Road might look like under different possible states of development. A standard device for analyzing the function of intersections is that provided in the Highway Capacity Manual.^{*} It is a series of formulas involving roadway dimensions; volumes per hour on different intersection approaches; and the length of 'critical gaps' in the traffic flow which are necessary in order for cars safely to make left turns and cross or enter from a stop sign. The result is a measure of 'reserve' or unused capacity which is translated into a level of service from A to F.

To get an idea of the range of potential traffic impacts of development in District 8, the Whitcomb Road/Hill Road intersection was analyzed using the highest and lowest estimates of traffic volumes along Whitcomb Road from Table III. These are respectively: scenario 2B, in which all of the traffic from District 8, developed for office use, is funneled onto Whitcomb Road; and 3A, in which the district is built up entirely with industrial uses, and only 41% of the traffic generated uses Whitcomb (the other 59% using Leonard Road). In order to complete the analysis, it was necessary to include a figure for the volume of traffic traveling along Hill Road but not related to the development in district 8. The figure arbitrarily was 100 vehicles in each direction during the peak hours. While this is much more than go past the Whitcomb Road intersection now, it stands to reason that development of district 8 would be accompanied by development in the area generally and so by an increase in background traffic. It was also assumed that traffic entering and leaving district 8 by Whitcomb Road would be divided evenly between those using Hill Road north and Hill Road south.

The high-density scenario (2B) would clearly create an untenable situation at the Hill Road/Whitcomb Road intersection and all along both roads. In fact, the analysis of the intersection function breaks down at the point of estimating the potential capacity for left turns off Hill Road onto Whitcomb, indicating the amount of traffic which district 8 would put onto Whitcomb under these conditions would greatly exceed its capacity. In all probability, were such a scenario to develop over a period of years, the need for traffic engineering improvements such as widening of Hill Road and signalization of its intersection with Whitcomb Road would have become evident long before these final build-out conditions had been realized.

Under the low-density scenario, traffic conditions would not be so bad; in fact they would be well within the acceptable range and would probably not require engineering improvements at the intersection or on Hill Road. In standard traffic engineering terms, if district 8 were developed with relatively low-traffic-inducing light-industry facilities, and if access to the district were provided by cul-de-sacs from Whitcomb and Leonard Roads, the 'levels of service' on the approaches to the Whitcomb/Hill intersection would all be acceptable, both in the morning and evening rush hours; in fact, the only approach whose level-of-service would be lower than 'B' - signifying 'short traffic delays' - would be the left turn from Whitcomb Hill during the morning peak hour, for which the level of service would be 'C' ('average traffic delays').

^{*} Transportation Research Board, Special Report 209, National Research Council

It should immediately be pointed out that these scenarios are evaluated here strictly in terms of their traffic function. The impact of the traffic on the adjacent properties is not considered. Level-of-service 'C' represents an acceptable level of congestion, but nonetheless, it represents a heavy, continuous stream of vehicles passing by the homes on Hill Road. Furthermore, the same 'average traffic delays' which would face drivers turning left onto Hill Road from Whitcomb in the morning would in all probability exist for people exiting from their driveways all along the west side of Hill Road. In short, even with a moderate level of development, with the most favorable distribution of traffic onto Whitcomb Road, the traffic conditions along Hill Road would be completely transformed. The currently quiet country road would become busy with commuter traffic.

It should be kept in mind that both the above scenarios posit a situation in which all the lots in District 8 are developed, with either industrial or office facilities, to the maximum density allowed by zoning. Such an event is unlikely ever to be realized; it should instead be viewed as an extreme case. For the sake of comparison, it can be noted that in the Waltham-Lexington area of Route 128 - which is generally perceived to be fully built up - current zoning would permit a tripling of the floor space which exists now.

In addition to the obvious lesson of the Waltham-Lexington case -- that even a developed area is unlikely to have exhausted the potential for squeezing buildings and floor area onto lots -- there is another, having to do with cycles of development. The period between 1951, when Route 128 opened, and the early 1970's saw the Waltham-Lexington area grow with high-tech corporate headquarters until it became densely built and began to experience traffic congestion. In recent years, however, the great growth of the Massachusetts economy has touched off another round of development in the same area. Many developed properties are now being 'recycled', with low-intensity uses being replaced by much higher-intensity. The result is that the reserve capacity that remains under zoning regulations, the two-thirds of the allowable square footage which has not yet been utilized, is in fact being tapped in a second cycle of growth. This is not to say that in the near or distant future, the intensity of land use in the Waltham-Lexington area of Route 128 will triple. The point is that growth in Boxborough in the I-495 corridor can be expected to occur in phases over a period of decades. Once the transportation infrastructure is in place, and as long as zoning permits growth, growth is inevitable.

Traffic Management at Hill and Whitcomb

The above estimates show the potential for a serious traffic impact on Hill Road if access to District 8 is via Whitcomb Road. A degradation of the quality of residential life along Hill Road might result, with an accompanying decline in property values. Yet it may not be possible to provide access to District 8 without using Whitcomb Road. The option of serving all the lots of District 8 by a single long cul-de-sac extending

from the present Leonard Road may not in reality be feasible, because such a cul-de-sac would have to be over a mile and a half long. While neither the town's Zoning Bylaw nor its Subdivision Regulations prohibit such a design, generally accepted guidelines limit the length of dead-end streets to 1000 or 1200 feet. Anything longer is unadvisable from the point of view of emergency access. A fire, flood or other event which blocked the road near its beginning would seal off the entire district, preventing entry and escape. (The same considerations argue against a single dead-end road originating from Whitcomb.)

If the only practical ways of providing access to District 8 utilize Whitcomb Road, the question becomes how to minimize the impact of traffic going from Whitcomb onto Hill and vice versa. One way of approaching the problem would be to consider blocking off Hill Road north of Whitcomb Road to traffic generated by District 8. This measure would protect the largest portion of Hill Road's length from commuter traffic, directing that traffic instead onto the relatively short section of Hill Road that runs south of Whitcomb to Route 111. In effect, this strategy would 'sacrifice' traffic conditions on the 2000 feet of Hill Road south of Whitcomb Road, in exchange for preserving the tranquility of the almost two miles to the north.

There are a number of ways traffic generated by District 8 could be routed toward Route 111, including installing physical barriers and making Hill Road one-way southbound. The method which would be least disruptive for residents along and other users of Hill Road, however, would be signage prohibiting right turns onto Whitcomb from Hill southbound and requiring right turns onto Hill from Whitcomb. (In actuality, a "right turn" onto Whitcomb from Hill involves going straight rather than following Hill as it turns left.)

The problem with such a measure is one of enforcement. A driver whose other trip end is served by Route 2 will be tempted to cheat and use Hill Road from the north; likewise one using Route I-495 to and from the north. Aggressive signage, however, and periodic crackdowns by local police might suffice to compel compliance.

To funnel all the traffic generated by District 8 onto Hill Road and south to Route 111 would degrade traffic and residential conditions on that portion of Hill Road, and would also add to congestion at the intersection of Hill and Route 111 which already is anticipated as a consequence of other planned developments in the area.

If the problem of how best to serve District 8 is seen as a tradeoff between impacts resulting from the uses of Whitcomb versus Leonard Road, it must be acknowledged that Leonard Road also has drawbacks. Although only a short section of it lies within Boxborough, it also runs through a lightly developed area of Littleton, intersecting Hill Road near Liberty Square Road. The interests of the town of Littleton should be taken into account if plans are made to put large amounts of traffic onto Leonard Road.

Policy Options

Zoning Changes

The zoning solution which would involve the least change over current conditions would be the addition of a provision to the zoning bylaw allowing, by special permit, the use of land in agricultural-residential zones as access ways to serve land in industrial-commercial zones. Such a provision would allow owners of lots fronting on Hill Road to apply for permits to build access drives to District 8. If permits were granted, of course, traffic to and from District 8 would use all of Hill Road and the residential quality of the area would be disturbed. See Appendix 1 for a sample zoning bylaw section.

One reasonable response to the problems posed by industrial/commercial development of District 8 would be to downzone the area, changing it back to residential use. This step would at once ensure that traffic could be kept at manageable levels and remove the access problem, since it would then be possible for developers to build roadways across the residentially-zoned land between District 8 and Hill Road.

If the town feels that single-family homes are not appropriate for an area bordering on an interstate highway, or if it desires the larger tax revenues derivable from land having values higher than those attaching to agricultural-residential land, District 8 could be rezoned as 'residential-1', permitting apartment houses. At the same time, it would be appropriate to amend the intensity regulations of the zoning code to establish a limit on the density of dwelling units allowable in the 'residential-1' zone, so that some control over the amount of traffic generated by apartment-house development in District 8 (and elsewhere) is possible. A good rule of thumb is that apartments in rural and suburban areas generate about six trips per day each.*

With a rezoning of District 8 to 'residential-1', the problem of using an agricultural-residential zone as an accessory to a different zone would remain. If it were intended that access drives be built between Hill Road and District 8, the special permit provision described above would also have to be put into the zoning bylaw.

If the town is determined to leave District 8 zoned for commerce and industry, it is still possible to exert influence on the intensity of development by creating a new zoning category such, for instance, as "light-industry" (or "industrial-commercial-1") which would permit the same uses as "industrial-commercial", only at a lower density. A one-story height limit and a 15% lot-coverage provision, for example, would significantly reduce the potential for traffic generation within a district. To wit, if such restrictions were in place in District 8, under the 'worst-case scenario' from Table II, in which the entire district were developed to capacity with general office buildings and the high-end projection of traffic generation were realized, the potential number of

* "Development and Application of Trip Generation Rates," U.S. Department of Transportation, Federal Highway Administration, January, 1985.

weekday trip ends would be 19,000 (instead of 135,000 under present zoning conditions).

Public Road through District 8

Assuming District 8 is not downzoned to agricultural-residential and must be served either by public road or by private road lying entirely within its boundaries, the problem of providing access can be addressed in a number of ways. The town can simply undertake the expense of taking the right-of-way by eminent domain and constructing the road, or it can pursue various means of enlisting the assistance of developers who build in the district. One is the creation of a betterment district, the properties in which would be assessed the cost of the road. Mass. General Laws Chapter 80 (or alternatively Ch. 80A) specifically authorizes this approach.

Since the road would have to be installed before development could take place, the town would need to advance the funds for construction and then recover the costs incrementally as properties served by the road were developed. Under MGL Ch. 80, S. 13A, assessment of the betterment tax on unimproved properties may be delayed until buildings are constructed.

The town could also institute within the site plan review process a special permit which is granted in return for a fee proportional to the square footage of the buildings the developer proposes. Special permit practices can only be required, however, when the developer seeks to exceed in some way the limits established by zoning. Since the zoning in effect currently in district 8 allows quite intense development, it is not likely that all or many developers there would need to seek special permits. Special permit fees are usually used for improvements or projects which are desirable, such as open-space acquisition or low-income housing, but not for indispensable conditions of development such as access roads. If a special-permit exaction is to be effective in the case at hand, the district should be zoned so as to insure that development of most or all properties within it will require a special permit.

As for ways the Town can limit the amount of development in District 8, zoning is really the only legitimate, legally reliable tool. The withholding of water or utility hookup permits, for example, is permissible only for reasons directly related to the utility or resource itself. A town's refusal to extend water lines to a subdivision can only be justified in terms of the costs, broadly speaking, of providing water, not in terms of the traffic or other problems caused by the development to which the water would be provided. Through such mechanisms as local environmental review, site plan review and performance standards, the Town can ensure that whatever development does take place is in accordance with community standards. Land banks can be used to reserve land altogether from development. But it is only through zoning that the community's interest in matters of land-use intensity can be expressed.

Within the context of zoning regulations, there now exists a variety of techniques for shaping development. Phased-growth ordinances can give a community a chance to plan its infrastructure improvements. Planned unit developments can give developers the flexibility to reconcile their construction programs with open-space and design amenities. And, as suggested above, by downzoning all or part of District 8 - to agricultural-residential, residential-1, or some new category such as low-density industrial - the development and traffic generating potential of the area can be regulated with some precision.

The problem of how the land within district 8 can best be made accessible and used is a complicated one. Past action and inaction on the part of the Town of Boxborough, coupled with the lack of options under the zoning bylaw, have effectively rendered the land unusable under present conditions. Either the zoning will have to be changed to allow uses, access to which will be possible across the adjacent residential land (that is, District 8 itself rezoned to agricultural-residential or the addition of a special permit provision), or the town will in one way or another have to see that a public road is installed which serves District 8. If the GenRad project goes forward as planned, access will be possible only via Whitcomb and Leonard Roads. The traffic which would be generated if District 8 were fully developed at industrial-commercial densities would put a heavy burden on those and other local roads. To create a public road through District 8 would also entail the cost to the town of right-of-way acquisition and construction.

Conclusion

This report has shown the probable range of traffic volumes which would result from the full-scale development of District 8 as it is currently zoned; examined the options for providing access to the district; discussed the probable effects of different access configurations on the surrounding area; and proposed actions on the part of the Town which would help realize the Town's objectives, whatever they may be. It is now up to the town to decide what those objectives are: to choose between development of District 8, with all the consequences for Hill Road, or some sort of downzoning, which means forgoing future tax revenue. If the former path is preferred, it remains to be determined how access to the district will be designed, and financed.

Particularly with regard to questions of zoning and of infrastructure financing techniques - special permits, betterment districts, direct developer contributions, etc. - the Town may benefit from consultation with MAPC staff. This report provides a clarification of issues and a framework for further discussion with the Town of Boxborough. If necessary, MAPC transportation planners, land use planners and legal staff will meet at the MAPC offices with Boxborough officials to help them refine specific policy proposals.

APPENDIX 1
DANVERS ZONING BYLAW

I.* Access to and egress from land in a different district shall only be allowed if no alternate access to or egress from is available. In such cases, access to and egress from land in a different district shall be allowed provided that:

- a. The land is appurtenant to the land in the different district.
- b. The width of the right-of-way is at least fifty-four (54) feet wide.
- c. The right-of-way is at least seventy-five (75) feet from the adjoining lot lines in the more restricted district.
- d. Screened areas fifteen (15) feet wide shall be provided in the buffer area on both sides of the right-of-way. The screened area shall abut the lot lines and be densely planted with shrubs or trees which are at least five (5) feet high at the time of planting which screening shall not obstruct the view of oncoming traffic when entering or exiting from the property. The planted material, in all respects, shall be maintained in a healthy condition.
- e. Lots of land which are in existence at the time of adoption of this bylaw and which because of their configuration and as a result of 2a, b and c above, at the time of the adoption of this bylaw cannot be used for the less restricted use because of insufficient access, may be used in their entirety for the purposes of the adjoining district and all provisions of this bylaw relating to the adjoining districts shall apply.

* Approved Attorney General October 6, 1978

